THE FOSSIL COLLECTOR

BULLETIN No. 54 **MAY 1998**

Snails from the Broken River Province, north Queensland. Top left, *Brokenriveria pharlapensis*, side view x2.7; top right *Murchisonia (Murchisonia) lawlessi*, apertural view x4; bottom *Gemininodosa langi*, apical view x4. See inside for more.

Published by
THE FOSSIL COLLECTORS' ASSOCIATION OF AUSTRALASIA
ISSN 1037-2997

THE FOSSIL COLLECTORS' ASSOCIATION OF AUSTRALASIA

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OBITUARY

SHEILA BENNETTS, 1918-1998.

It is with deep regret that we have to report that Sheila Bennetts, a foundation member of the Association, passed away on January 9th, 1998, aged 79. As well as being a dedicated amateur palaeontologist and a keen mineral collector, she also taught geology at the University of the Third Age, which she helped establish in Shepparton.

Since her husband Garth died in September 1987, Sheila devoted a considerable amount of her time to the study of the eastern Australian occurrence of the extinct Mesozoic plant group Pentoxyleae. Unfortunately, although her work on the study was nearing finality, a small but important part of her research remained incomplete at the time of her death. As a tribute to Sheila, it is sincerely hoped that someone can be found to complete the project. It would indeed be a great pity if her many years of work were to no avail.

While most of us in the F.C.A.A. got to know Sheila through her interest in geology, it was her commitment to social issues for which she will be remembered in the Shepparton area of Victoria, not the least of which was her involvement in setting up a women's refuge and in helping migrants to assimilate.

Our sincere condolences are extended to Sheila's family: she will be sadly missed by her friends in the Association.

Frank Holmes.

EDITORIAL NOTES

Welcome to the Queensland edition of *The Fossil Collector*. I am grateful to the professional palaeontologists who have taken the time to prepare and contribute material for this issue as without them I would have been in the same situation as I have been before, that is how am I to fill a minimum of twenty four pages. What makes this even more extraordinary is the fact that these people also spend some time justifying their positions to government departments. I am proud of the fact that professional palaeontologists consider *The Fossil Collector* a worthy publication to have their material published in, I hope we maintain this standard in the future and can thus look forward to more contributions from the professional community.

Planning for this winters field trip is now well underway and to say that I am excited about it would be an understatement. This year, we will be spending three weeks in the field visiting localities around the Walsh River area, far north Queensland (Cretaceous), the Broken River Province, north Queensland (Devonian), Cretaceous localities in western Queensland and perhaps, if time permits, Carboniferous and Holocene localities on the central Queensland coast. Total travelling distance will be more than 5,000 kilometres which might seem a long way but the country we will be seeing will make it all worthwhile, not to mention some of the fossil localities that we will be visiting are some of the best invertebrate localities in Queensland. This year I will also be fulfilling another of my interests, that of astronomy, as I am planning on taking one of my telescopes with me. The lure of some dark skies as well as what I consider the best time of the year to observe the stars has been a little bit too much of a temptation for me.

This years field trip will also see the continuation of the introduction of technology in the field. This will be the second year now that I have been able to take a digital camera and computer on a field trip with me, to be able to photograph a locality then view the images straight away is what I consider a great advantage in recording information.

As I will be in the field from the middle of August it is necessary to bring the deadline for the next issue, Bulletin 55, forward to July 1. This will enable me have Bulletin 55 finished and sent off to the printers before I leave on my field trip and thus not delaying its release.

DEVONIAN SNAILS FROM THE BROKEN RIVER PROVINCE, NORTH QUEENSLAND

Natalie Camilleri. Queensland Museum, PO Box 3300 South Brisbane, Qld 4101.

The Broken River Province, near Greenvale in North Queensland, contains one of the most diverse warm water, marine fossil fauna assemblages in Eastern Australia. It has been the subject of intense scientific study with a comprehensive amount of information gained on the fossil fauna of the area and Devonian reefal environment it represents. The type of material previously studied and published include conodonts (Mawson, 1987; Mawson ct al, 1988; Mawson & Talent, 1989), corals (Wyatt & Jell, 1967), crinoids (Jell, 1988), stromatoporoids (Mallet, 1971), nautiloids (Cook & Wadc, 1997) and fish (Turner, 1982, 1995; de Pomeroy, 1994). Up until now, its fossil gastropod assemblages have remained unstudied.

For the past few years Dr Alex Cook and myself, from the Invertebrate Palaeontology section of the Queensland Museum, have been studying Middle Devonian (Eifelian and Givetian) gastropods from the Papilio Mudstone, Dosey Limestone and Burgess Formation of this area. This article illustrates the gastropods wc have recovered and published so far and the work we wish to do in the future.

A THANKYOU

We would like to acknowledge the tremendous help we received throughout this project from Scott Hocknull and Paul Tierney to whom we are greatly indebted. The exercise has been a great example of the way in which professional and amateur palaeontologists can work together and both gain great enjoyment from the experience. For the volunteers, the experience of being an integral mcmber of the team, from the organising of the field trip, through to the discovery, preparation and registration of the specimens, combined with travelling to a remote and rugged area has been rewarding. For the museum, having reliable and enthusiastic help has been crucial to the success of the whole project.

LOCATION AND BACKGROUND

Lying approximately 200 km west of Townsville, the Broken River Province

comprises an area of approximately 15,000 square kilometres. Not only is the area richly fossiliferous but it is endowed with amazing scenery, including deep gorges, karst topography and intricate cave systems. It is also host to an array of small mineral deposits and has been mined for gold, antimony, uranium, tin, tungsten, chromite and nickel.

Figure 1. Location of the Broken River Province.

GEOLOGICAL SETTING

The Broken River Province forms part of the northern section of the Tasman Fold Belt. It is a deformed sedimentary terrain which has been faulted against lower Palaeozoic rocks of the Ravenswood-Lolworth block to the south and Proterozoic rocks of the Georgetown Inlier to the north-west, (Jell et al 1988). It contains two tectonically distinct subprovinces separated by the Gray Creek Fault Zone. The Camel Creek Subprovince, to the east, is intensely deformed and consists predominantly of turbidites but also contains volcaniclastics, quartz rich arenite

and oolitic limestone. The Graveyard Creek Subprovince, to the west, is less deformed and contains limestone, siltstone, arenite and conglomerate, it contains a much more coherent stratigraphy and is the basin from which the fossil gastropods were collected. For more detailed information on the Broken River Province geology see Withall and Lang (1993).

PREPARATION OF THE GASTROPODS

Gastropods from the Papilio Mudstone and Burges Formation were found eroded out of their surrounding matrix, lying loosely on the ground, they required cleaning and a little mechanical preparation to reveal their finer morphological details. However, the gastropods of the Dosey Limestone existed as external moulds within the surrounding rock. When posed with this situation, black rubber latex is used to infill these moulds, once set the latex is removed to reveal reproductions of the original gastropod. Although a time intensive task, the surficial detail revealed under the binocular microscope is well worth the effort. To prepare the latex's for photography it is necessary to whiten the casts by dusting them with a layer of ammonium chloride sublimate, this is done in order to enhance the morphological detail of the specimen. When applied, the sublimate tends to collect more rapidly on raised areas of the latex's as opposed to depressions, this, combined with the dark background colour of the latex's has the effect of enhancing relief, increasing sharpness and reducing undesirable highlights when the specimens are photographed.

FAUNA

A total of twenty seven taxa of gastropods have been described, with four new genera and ten new species. New taxa are: *Denayella lomandraensis*, *Gyronema simpsoni*, *Frillbeastia queenslandicus*, *Brokenriveria pharlapensis*, *Gemininodosa langi*, *Murchisonia (Murchisonia) wandovalensis*, *M. (M.) lawlessi*, *Palaeozygopleura dodgeyi*, *Australoxa tasselli* and *Leptogyma queenslandicus*. The complete list of gastropod fauna includes:-

Bellerophon (Bellerophon) sp. A.
Bellerophon (Bellerophon) sp. B.
Straparollus (Straparollus) sp.
Straparollus (Euomphalus) sp. A.
Straparollus (Euomphalus) sp. B.
Labrocuspis nodosa Heidecker

Omphalotrochid indet.
Frillbeastia queenslandicus
Gemininodosa langi
platyceratoid indet.
Stylonema? sp.
Palaeozygopleura dodgeyi
Mitchellia striatula de Koninck
Murchisonia (M.) sp.
Denayella lomandraensis
Brokenriveria pharlapensis
Platyceras (Platyceras) sp.
Burdikinia burdekinensis
Australoxa tasselli
Leptogyma queenslandicus
murchisoniid indet
Murchisonia (Murchisonia) lawlessi
Murchisonia (Murchisonia) wandovalensis
Murchisonia (M.) sp. cf. *M. (M.) fermioni* Tassell
Soleniscus sp. cf. *S. subcostata* Schlotheim

COMMUNITIES RECOGNISED

Three late Devonian (Givetian) gastropod communities were recognised; *Labrocuspis* community, *Brokenriveria* community and *Murchisonia* community, these represent different sedimentologic regimes. The *Labrocuspis* community, of the Papilio Mudstone, is found in conglomerates and course sandstone's deposited in high energy nearshore palaeoenvironments. The *Brokenriveria* community, also of the Papilio Mudstone, exist on a shallow, low energy, open marine impure carbonate shelf. The *Murchisonia* community, found in the Dosey Limestone, is interpreted as representing a peri-reefal palaeoenvironment because of its association with corals, stromatoporoids and sponges.

FAUNAL AFFINITIES AND FUTURE STUDY

Examination of the fauna indicates affinities to gastropods known from the Devonian of Europe and North America, particularly Germany and England. However, we have a very poor knowledge of Devonian snails in Southeast Asia, areas crucial to our understanding of palaeobiogeography. More recently, work has commenced on gastropod faunas from the Devonian fossil reef complexes of Western Australia, in both the Canning and Bonaparte Basins.

All images in the following figures have been whitened with ammonium chloride sublimate for photography.
Abbreviation: QMF, Queensland Museum.

A

B

C

F

D

E

Figure 2. A, *Straparollus (Euomphalus)* sp. B, QMF34752 x2.2. B, *Straparollus (Euomphalus)* sp. A, QMF33352 x3.1. C, *Stylonema*? sp. latex mould of QMF33102 x7. D, E, *Straparollus (Straparollus)* sp., latex moulds from QMF34267 x3.1, D, apertural view; E, apical view. F, *Murchisonia (M.)* sp. cf. *M. (M.) fermioni* Tassell, 1982., latex mould of QMF33701 x3 side view.

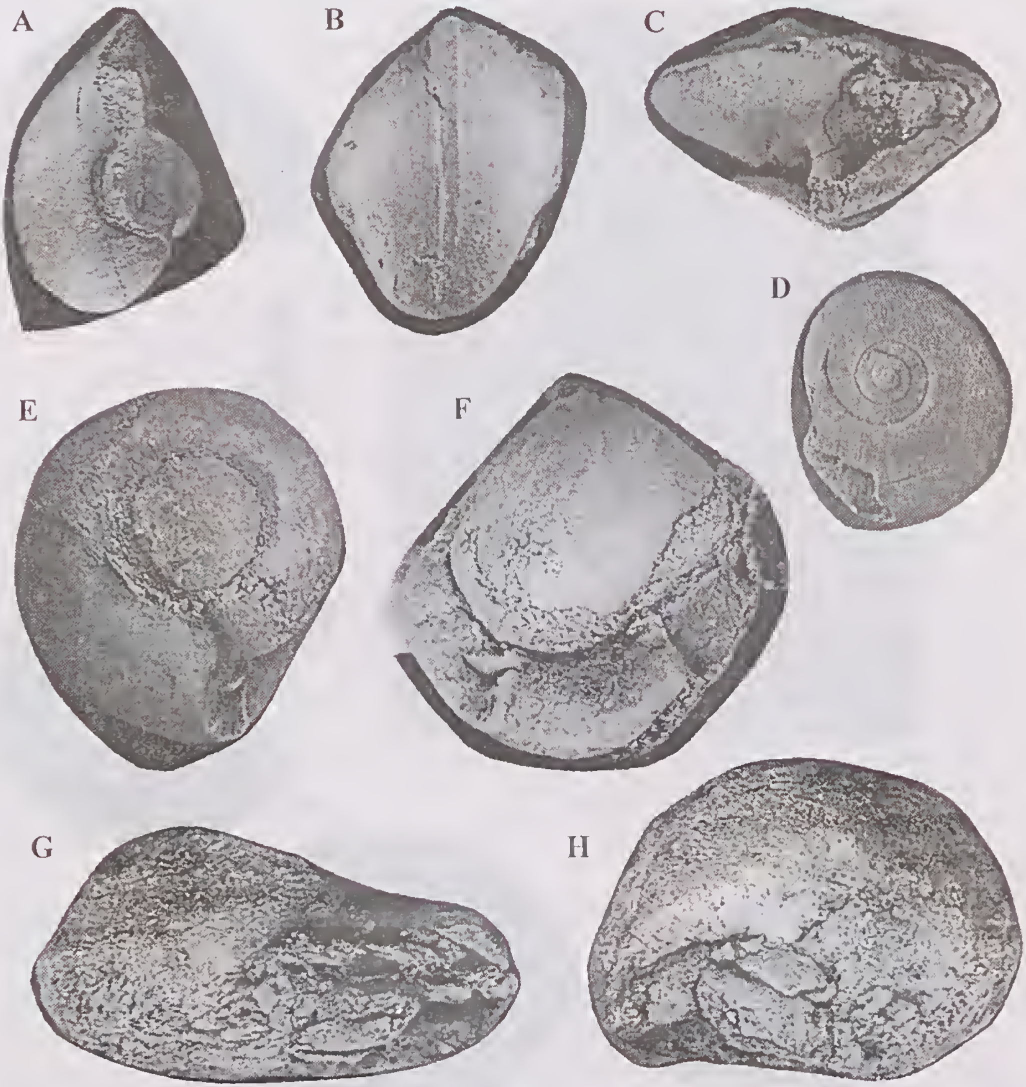

Figure 3. A, B, *Bellerophon (Bellerophon)* sp. B., QMF33621 x2.7, A, side view; B, view of selenizone. C, D, *Denayella lomandraensis* sp. nov., Holotype QMF33650 x6, C, apertural view; D, apical view. E, F, *Bellerophon (Bellerophon)* sp. A., QMF32642 x2.2, E, side view; F, apertural view. G, H, *Burdikinia burdekinensis* (Etheridge, 1917), QMF33579 x2, G, apertural view; H, apical view.

Figure 4. A-C, *Labrocuspis nodosa* Heidecker, 1959, QMF33583 x1, apertural, apical and basal views respectively. D, Omphalotrochid indet., latex mould from QMF33687 x2, apical view. E, F, *Platyceras (Platyceras)* sp. QMF32641 x2.7, E, apical; F, side view.

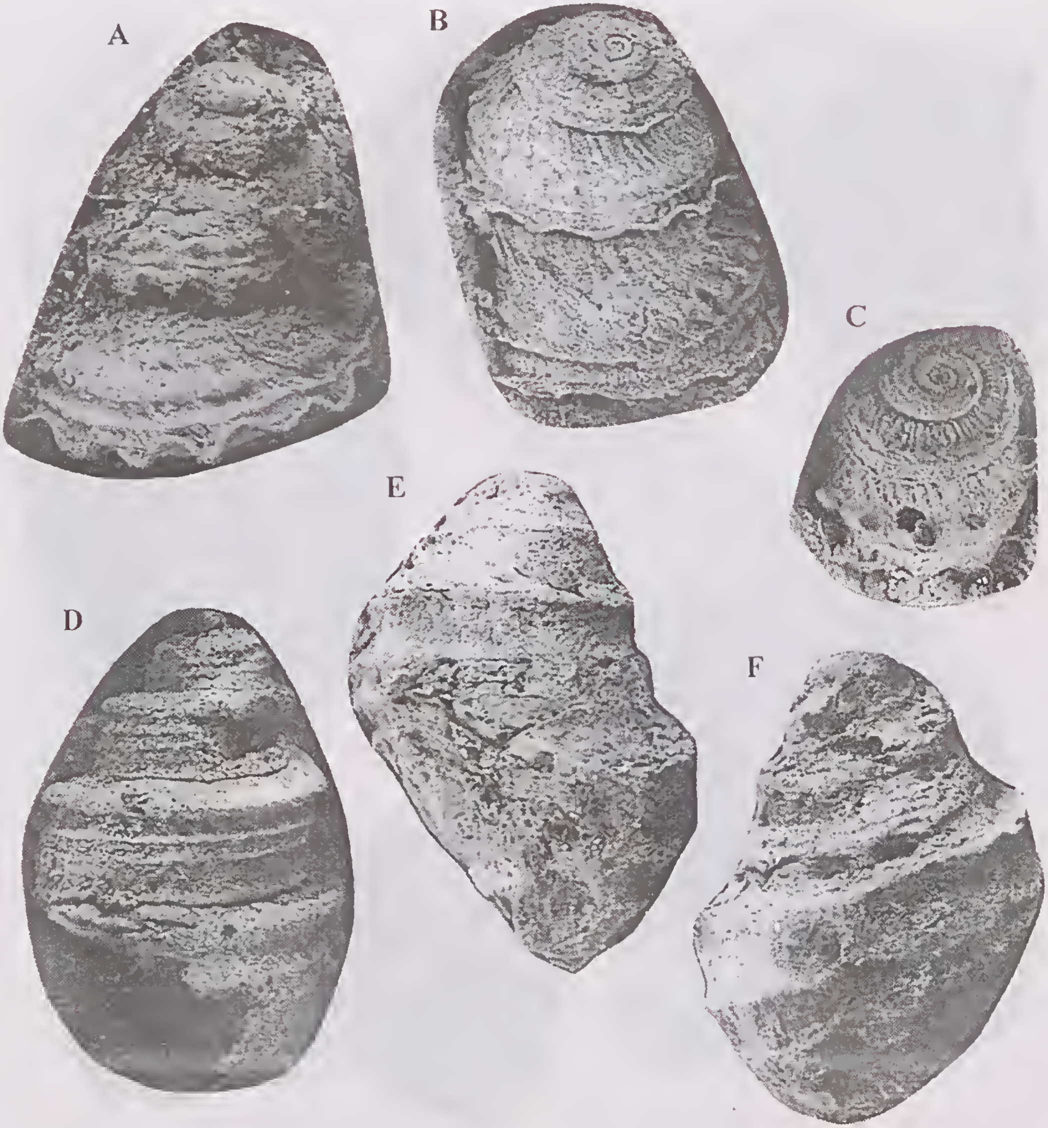

Figure 5. A-C, *Frillbeastia queenslandicus* gen. et sp. nov. A, latex mould of Holotype QMF33687 x3.6; B, C, latex mould of Paratype QMF34265 x3.1 & x4.5 respectively, B, side view, C, oblique view showing protoconch. D, Murchisoniid indet., latex mould of QMF33100, side view x1.8. E, F, *Gyronema simpsoni* sp. nov. Holotype QMF32082, x1.3. E, apertural view; F, side view.

Figure 6. A-C, *Brokenriveria pharlapensis* sp. nov. A, Paratype QMF32268 x2.8, side view; B, C, Holotype QMF32234 x3, B, apertural view; C, apical view. D-G, *Gemininodosa langi* gen et. sp. nov. D, E, Holotype QMF33611 x3.3, D, apical view; E, side view; F, Paratype QMF33638 x3.4, side view; G, Paratype QMF32182 (crushed specimen) x4, apertural view.

Figure 7. A, B, *Murchisonia (Murchisonia) wandovalensis* sp. nov. Holotype QMF33680 x4.7, A, side view; B, apertural view. C, D, *Murchisonia (Murchisonia) lawlessi* sp. nov. C, latex mould of Holotype QMF33704 x3.1, side view; D, latex mould of Paratype QMF33096 x3.6, apertural view. E, *Murchisonia (Murchisonia)* sp. QMF33686 x3.5, apertural view. F, Platyceratoidea gen. et sp. indet. QMF34224 x3.7, apertural view. G, *Mitchellia striatula* (de Koninck, 1876) QMF32643 x2, apertural view.

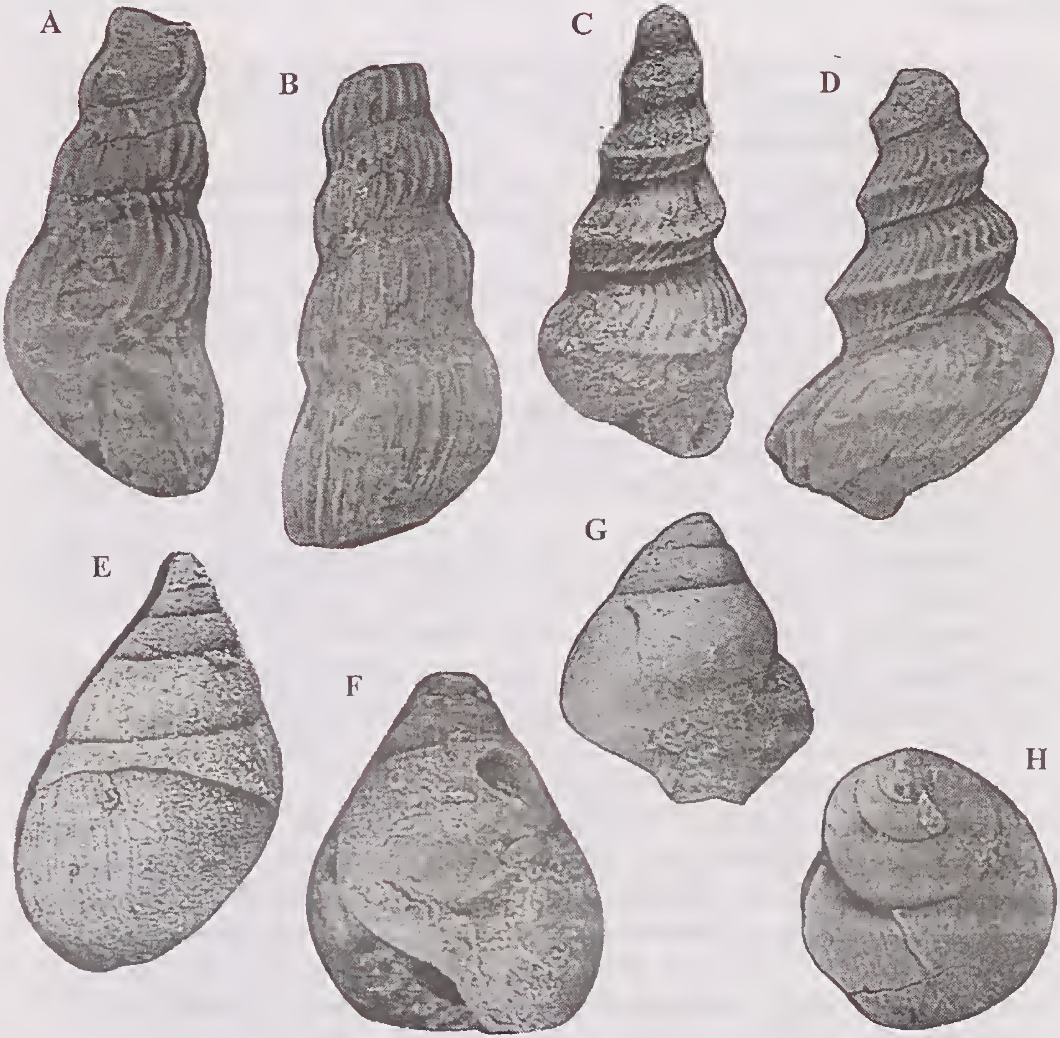

Figure 8. A, B, *Palaeozygopleura dodgeyi* sp. nov., Holotype QMF33608 x3.5, A, apertural view; B, side view. C, D, *Australoxa tasselli* gen. et sp. nov. C, Holotype QMF33586 x3.3 apertural view; D, Paratype QMF33589 x3.5 side view. E, *Soleniscus* sp. cf. *S. subcostata* Schlotheim, latex mould of QMF33692 x2. F-H, *Leptogyma queenslandicus* sp. nov. F, Holotype QMF33673 x6.3 apertural view; G, H, Paratype QMF33213 x6.3, G, apertural view; H, oblique view.

References

Cook, A. G., Wade, M. 1997., Symbiotic Stromatoporoid-Nautiloid Association, Middle Devonian, North Queensland. *Memoirs of the Queensland Museum* 42 (1): 81-89.

Jell, P. A., Jell, J. S., Johnson, B. D., Mawson, R., Talent, J. A., 1988. Crinoids from Devonian Limestones of Eastern Australia. *Memoirs of the Queensland Museum* 25 (2): 355-402.

Mallet, C. W., 1971. Devonian stromatoporoids from the Broken River Formation, North Queensland. *Journal of Proceedings of the Royal Society of New South Wales* 103 (1): 35-42, pls. 1-2.

Mallet, C. W., 1971. The stromatoporoids genera *Actinostroma* Nicholson and *Nexililamina* gen. nov. from the Devonian Broken River Formation, North Queensland. *Proceedings of the Royal Society of Victoria* 84920: 235-244, pls. 13-14.

Mawson, R., 1987. Documentation of conodont assemblages across the Early Devonian-Middle Devonian boundry, Broken River, North Queensland. *Courier Forschungs-Institut Senckenberg* 92: 251-273.

Mawson, R., Talent, J. A., 1989. Late Emsian-Givetian stratigraphy and conodont biofacies-carbonate slope and offshore to sheltered lagoon and nearshore carbonate ramp, Broken River, North Queensland. *Courier Forschungs-Institut Senckenberg* 117: 205-259.

Mawson, R., Talent, J. A., Bear, V. C., Benson, D. S., Brock, G. Z., Farrell, J. R., Hyland, K. A., Pyemnont, B. D., Sloan, T. R., Sorentino, L., Stewart, M. I., Trotter, J. Z., Wilson, G. A., Simpson, Q., 1988. Conodont data in relation to resolution of stage and zonal boundries fro the Devonian of Australia pp 485-527. In McMillan, N. J., Embry, a. F. & Glass, D. J. (eds) *"Devonian of the World"*. Volume 3. (Canadian Society of Petroleum Geologists: Calgary).

de Pomeroy, A. M., 1994. Mid-Devonian condrichthyan scales from the Broken River, North Queensland, Australia. *Memoirs of the Queensland Museum* 37 (1): 87-114.

Turner, S., 1982. Middle Paleozoic elasmobranch remains from Australia. *Journal of Vertebrate Paleontology* 2: 117-131.

Turner, S., 1995. Devonian thelodont scales (Agnatha, Thelodonti) from Queensland. *Memoirs of the Queensland Museum* 38: 677-685.

References cont

Withall, I. W. & Lang, S. C. (eds), 1993. Geology of the Broken River Province, North Queensland. *Queensland Geology* 4, 292pp.

Wyatt, D. H., Jell, J. S., 1967. Devonian of the Townsville Hinterland, Queensland, Australia. Pp 99-105. In D. H. Oswald (ed.) *International symposium on the Devonian System*, Calgary, 1967. (Alberta Society of Petroleum Geologists: Alberta).

RECENT PUBLICATIONS

The current issue of the *Proceedings of the Royal Society of Victoria* contains the second of two papers by Dr Thomas Darragh, Museum of Victoria, on the molluscan fauna of the Pebble Point Formation which crops out on the Otway coast southeast of Princetown, Victoria. The second paper describes and illustrates the gastropods, scaphopods and cephalopods, as well as some new bivalves not included in the first paper.

Together the two papers provide details of 46 gastropod, 37 bivalve, 3 scaphopods and 2 cephalopod species from a Late Paleocene shallow water open sea environment.

References

Darragh, T. A., 1994. Paleocene Bivalves from the Pebble Point Formation, Victoria, Australia. *Proceedings of the Royal Society of Victoria* 106: 71-103 including 8 figures.

Darragh, T. A., 1997. Gastropoda, Scaphopoda, Cephalopoda and new Bivalvia of the Paleocene Pebble Point Formation, Victoria, Australia. *Proceedings of the Royal Society of Victoria* 109 (1): 57-108 including 12 figures.

Note: Copies of the Proceedings are available from the Royal Society of Victoria, 9 Victoria Street, Melbourne, Victoria 3000, Australia [Tel. (03) 9663 5259]. E-mail address: rsvinc@vicnet.net.au

RECOGNISING FOSSIL MAMMAL TEETH
Part 1

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Base Drawings. Chris Glen. P.O. Box 399 Noosa,Qld. 4567.

INTRODUCTION

Most vertebrate fossils found in Australia are mammals, so it's no surprise that most of those found by amateurs are mammals. The teeth are often the most resilient parts, and hence the most likely to be found, however, teeth are among the more difficult fossils for amateurs - not to mention some professionals - to identify. Although mammal teeth are the most widely used way of identifying fossil mammals, because the variety of tooth forms makes them diagnostic, the variety of different forms also makes learning which teeth belong to whom difficult. Furthermore, there is (almost) no information on identifying fossil mammals from bones (other than jaws with teeth), so we'll concentrate on recognising the different forms from their teeth. It is worth mentioning the one book available on identifying fossil mammals from bones, Merrilees & Porter, covers fossil mammals from Western Australia, but it is useful for the rest of the country as well. This series of articles aims to introduce the fossil teeth of mammals, so that they can be recognised and identified, we shall show how to recognise the different kinds of teeth in the different kinds of Australian mammals. Only representative species are included, so that hopefully the reader will be able to recognise a bandicoot tooth, but not necessarily identify it as from a Northern Brown Bandicoot. Fishes and tetrapods, other than mammals, will be mentioned but not discussed.

The form of the teeth, especially the molars, of placental mammals are unique to each species. Historically, teeth have played a large role in identifying and studying fossil mammals, as a result, teeth have received prolonged and detailed study, and a large and very complicated terminology for the features of the teeth has been developed. Not only are many of these terms incomprehensible to most amateurs, they are incomprehensible to about 95% of professionals (those who don't work with fossil mammals), as well. Luckily, one doesn't need to know all the terms to be able to recognise the teeth.

THE EVOLUTIONARY BACKGROUND OF MAMMAL TEETH

The earliest vertebrate teeth, those of fishes, are basically simple cones, we shouldn't be misled, however, into thinking that because these are the earliest and simplest of tooth forms, that all fish have such teeth. Modern fishes have had just as long an evolutionary history as modern mammals, and just as much time to have developed complicated teeth, and some did. Some shark teeth are flattened and triangular, serrated like knives, and other fish have flat cushion, or button-like teeth used to break mollusc shells, and there are also the crested, almost comb-like teeth of lungfish.

Originally, fish teeth were much the same in form regardless of where they were placed in the mouth and this is still the case in many fish. Others have evolved different tooth forms in different parts of the mouth, so that some fish jaws can be (and have been!) mistaken by the general public for those of cats, or even humans.

The lineage that led to mammals evolved more complex teeth very early on. Initially they were of different sizes in different parts of the jaw, but then they became different in form as well (Fig. 1). As recently as the 1960's (some) palaeontologists thought that all other lines of land dwelling vertebrates either lost their teeth (as did tortoises and birds) or retained simple, conical teeth of much the same form and size throughout the jaw. This belief was shattered by the discovery, in South Africa, of a dinosaur (*Heterodontosaurus*) with almost as many different forms of teeth as modern mammals, and similarly arranged in the jaws. It then turned out that some lizards and crocodilians also had teeth of different forms in different parts of their jaws - this had been known for some time (since the late 19th century), but only by the specialist studying those particular lizards or crocodilians. Some of these teeth were so similar to mammal teeth that there is an instance of Cretaceous crocodilian teeth (*Candidodon*) having been mistaken for mammal teeth. This greatly amused palaeontologists studying fossil crocodilians, but those who work on fossil mammals weren't equally amused.

Fish and reptiles continually replace their teeth, which is why where fossil crocodilian teeth are found at all, they tend to be common, somewhere during the evolution of the differentiation of their teeth, mammals gave up this ability (and hence paved the way for the dental profession). Mammals replace most of their teeth only once, the first set are known as deciduous or milk teeth, and second as

permanent teeth, molars are the exception, they are not replaced. It has been thought that this loss of 'throw away teeth' was the result of the evolution of the patterns on the crowns, and the corresponding precision in which upper and lower teeth must meet (occlude) in order to feed efficiently. This, in turn, is related to the evolution of a relatively high metabolic rate and constant body temperature.

Another feature of mammalian teeth which evolved early in their ancestry and may well have contributed to their evolution of a 'precision bite' and the complex patterns of the molar crowns, was the tooth socket. In fish and lizards the teeth often simply attach to the bone of the jaw, in mammals (and dinosaurs, crocodilians and even some fish) the teeth have roots that are set in distinct and often deep sockets. The teeth are held by connective tissue, which may allow some very slight movement of the crowns when the teeth come together, so contributing to the precise meeting of the teeth.

So, although mammals generally have developed the differentiation of their teeth to a fine degree, other vertebrates also have different forms of teeth in different parts of their jaws. However, most of these other vertebrates did not inhabit Australia, or at least have not yet been discovered, so fossil mammalian teeth found in Australia are readily recognized as being from mammals.

WHERE DOES THE TOOTH COME FROM: DIFFERENT KINDS OF TEETH IN THE JAW

In most mammals there are four different kinds of teeth (Fig. 1). Those at the front are simple, often bluntly bladelike in form, these teeth, the incisors, usually cut the food for eating. Just behind these are the canines, also called eyeteeth or fangs, these are often sharp, slightly curved cones in form, the canines may be used for killing prey, in carnivores and insectivores, and are often used in social displays. Canines may be lost in herbivorous animals.

Behind the canines are the cheek teeth, these take two forms, premolars and molars, the premolars are located between the canines and molars. Cheek teeth are more complex in form than incisors and canines as they have two or more low projections, or peaks, that arise from the biting surface, these projections are called cusps. Molars are the teeth most widely used in identifying fossil mammals, so we will look mostly at these and return to the others only where the molars are not

sufficient, or where there is some particular interest to the other teeth.

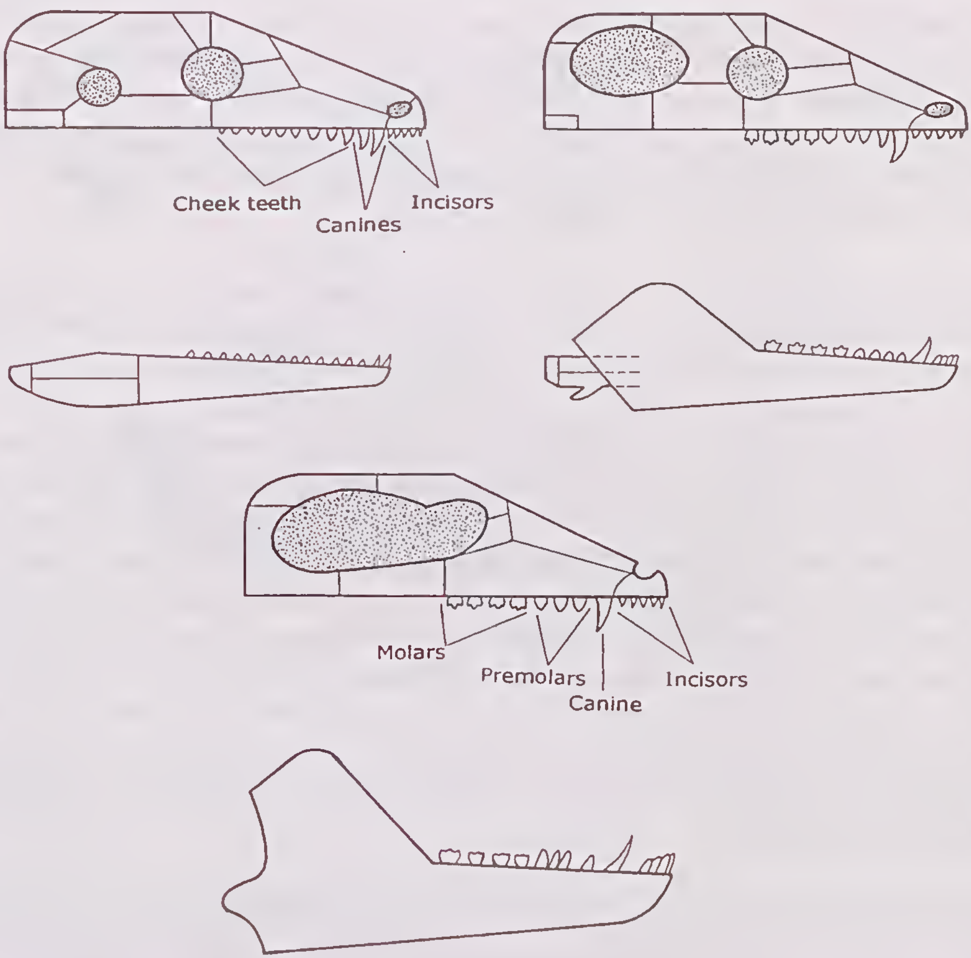

Figure 1. Schematic drawings showing the evolution of the teeth in mammals. In primitive mammal-like reptiles (pelycosaurs), at top left, the teeth differed mostly in size, their form being pretty much alike throughout the tooth rows, but there were the beginnings of the development of incisors and canines, the remaining teeth are called cheek teeth. In later, more derived mammal-like reptiles (therapsids), at top right, the teeth developed four forms, those of incisors (at the front), canines, premolars and molars (at the back). This arrangement was maintained in the mammals themselves, bottom. Figure not to scale.

MAMMALIAN TOOTH (MOLAR) FORM

Palaeontologists have long sought to make out the history of the evolution of mammalian teeth. Early in the twentieth century, they believed that the teeth of primitive therians (placentals + marsupials) provided a key to understanding the variety of forms of mammalian molars. Although the actual evolution appears to have differed somewhat from what was thought at the time, this scheme is still useful in learning to recognize and interpret molars.

Looking at the upper molar, of an early therian mammal, from its biting (occlusal) surface - its business end so to speak - we can see its triangular form. It bore three cusps, one at each angle, these are the paracone, metacone and protocone (Fig. 2). This is the simple, basic form to which all other mammalian upper molars are related. Lower molars are a bit more complicated, they have a triangle with a 'trailer' behind, the talonid (Fig. 2), the triangular portion, the trigonid, bears three cusps just like the upper molar, but to distinguish them from the upper cusps they are called the paraconid, metaconid and protoconid respectively. The two cusps of the talonid, which have no counterparts on the upper molar, are the hypoconid and entoconid (fig.2). The forms of the upper and lower molars of 'recent' (Cenozoic) mammals can be related to these, by the enlargement or reduction, or the addition (Fig.2) of subtraction, of cusps. Of course, the actual forms of the teeth are much more complex, with additional smaller cusps, 'valleys', ridges, etc., but a knowledge of the basic cusps goes a long way toward learning to identify and recognize mammal teeth.

In placental mammals and the carnivorous marsupials, the upper and lower molars differ in form. In most advanced (i.e., Plio-Pleistocene & Recent) marsupials the difference between upper and lower molars (and even premolars) is reduced, so that the tooth forms are basically similar, but some differences can be seen.

In identifying fossil mammal teeth, it should be remembered that:

1. tooth form varies:
    - from species to species,
    - also from tooth to tooth in the jaw, and
    - sometimes between the deciduous and permanent teeth.

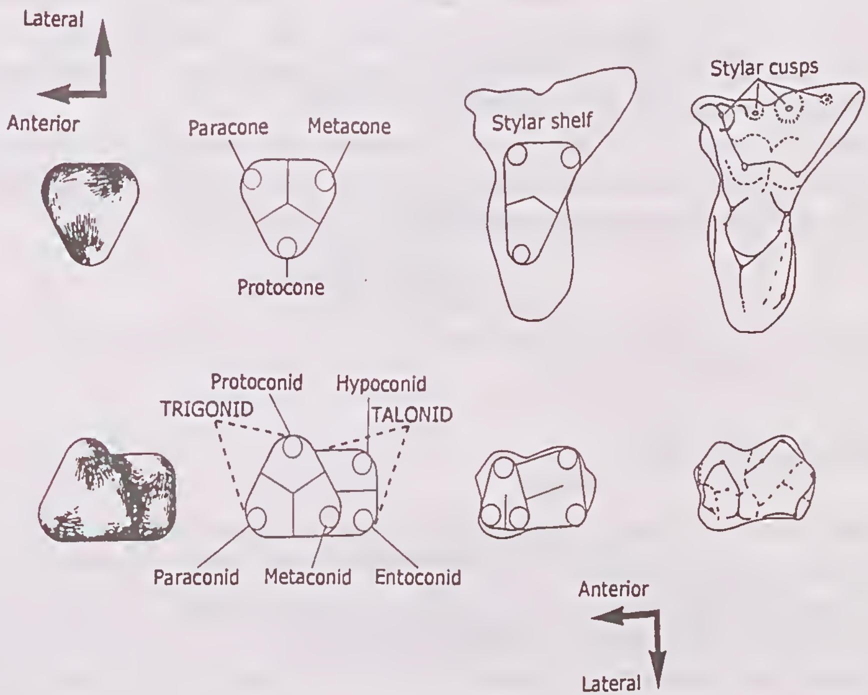

Figure 2. The scheme for identifying features of the crowns of primitive mammalian molar teeth. The molars are seen from the biting or occlusal surface, upper molars on top row, lower molar on bottom row. At left are the schematic forms showing the triangular, tricuspid form of the uppers and the trigonid and talonid of the lowers with five cusps, three on the trigonid and two on the talonid. To the right of these are diagrams of these schematic forms with the cusps represented by small open circles and labeled and the 'valleys' between them represented by thin lines. For comparison, far right, are some actual Cretaceous mammal teeth, from *Gypsonictops*, a placental from North America. The images to the left of these show how the schematic pattern is applied to actual teeth. Although you can make out the pattern seen at left, you can also see that the occlusal surface can be a lot more complex. Some of the complicating features - additional cusps along the outer edge of the tooth (the stylar cusps) and the shelf (stylar shelf) that holds them - are labeled. Figure not to scale.

2. that tooth form is not always adequate for identifying some marsupial species. In other words, there are marsupials - the Mountain Possum (*Trichosurus caninus*) and the Brushtail (*Trichosurus vulpecula*), for example - whose teeth don't differ.
3. although the front teeth, the incisors, are sometimes useful for indentification (especially for kangaroos), it is the cutting teeth (premolars) and especially the grinders (molars) that are most useful.

Two marsupial groups, marsupicarnivors and bandicoots, have teeth that don't differ greatly from the basic pattern.

MARSUPICARNIVORS

The molars of carnivorous marsupials (the marsupicarnivors) are basically similar to this basic mammalian pattern. Marsupicarnivors include the quolls (*Dasyurus*, *Dasyuroides*), thylacines (*Thylacinus*), Tasmanian devils (*Sarcophilus*) and (so-called marsupial mice, like *Antechinus* and *Planigale*. All of these, except thylacines, are included in the dasyurids. The small 'mousy' forms show the basic pattern most clearly, but even thylacines and devils have the same fundamental form, this form is probably close to that of the teeth of the ancestral marsupials.

Antechinus is a small animal, and hence has small teeth, they are so small, only a few millimetres across, that they would usually only be recovered by sieving. Here we will use *Antechinus* as the example of a dasyurid, or basic marsupicarnivor molar. The upper molars are triangular in shape (Fig.3, top), like the basic tooth form described previously, however, the match is not perfect, dasyurids have a shelf along the outside of the tooth crown with low cusps on it. So it is the inner portion of the crown that corresponds to the basic molar tooth form. The protocone is reduced to a small cusp, about the size of those on the 'outside' (stylar) shelf (called stylar cusps). The final, back molar has this basic form, but much modified, with a smaller stylar shelf and a smaller metacone (Fig. 3, top, at left).

The lower molars are closer to the basic form (Fig. 3, bottom). The three cusps of the trigonid are the paraconid, protoconid and metaconid, and those of the talonid are the entoconid and hypoconid.

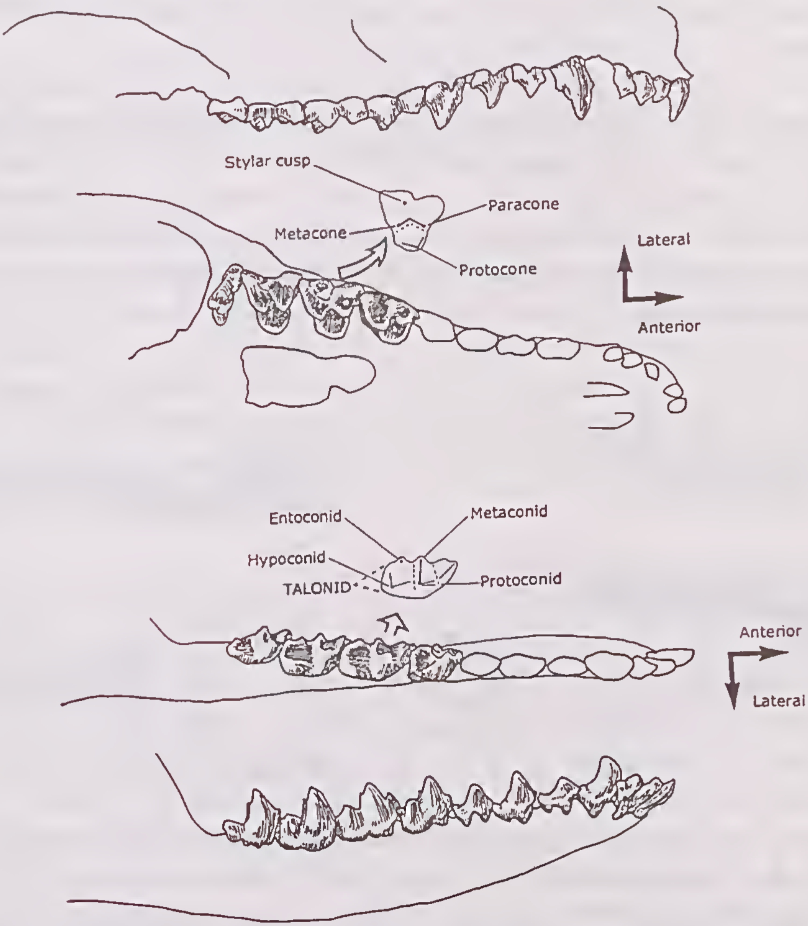

Figure 3. The teeth of a living Atherton Antechinus, *Antechinus godmani*, based on an actual specimen. The uppers are shown at top in both lateral and occlusal view, and lowers at bottom in the same views, one molar from both upper and lower jaws is diagrammed to point out the prominent features. Major cusps are indicated by dots, major ridges by solid lines and major 'valleys' by dashed lines. The upper molars have the basic triangular, tricuspid form medially, with a stylar shelf and one prominent and several smaller stylar cusps, except for the last (at left). The lower molars have a prominent talonid, only slightly lower than the trigonid. The paraconid is reduced (and hence not indicated on the diagram) and the protoconid is the largest cusp. Figure not to scale.

In two kinds of dasyurids, the teeth somewhat deviate in form from those described previously.

The Tasmanian devil, *Sarcophilus*, has developed a powerful bite and accordingly modified its teeth. In the uppers, the outside stylar shelf is very reduced giving a form closer to the basic form (Fig. 4, top). In the lowers, the talonid has also been reduced and the three basic cusps re-aligned to form an (almost) straight line (Fig. 4, bottom). Its teeth are generally more robust than the smaller, more graceful teeth of the other dasyurids.

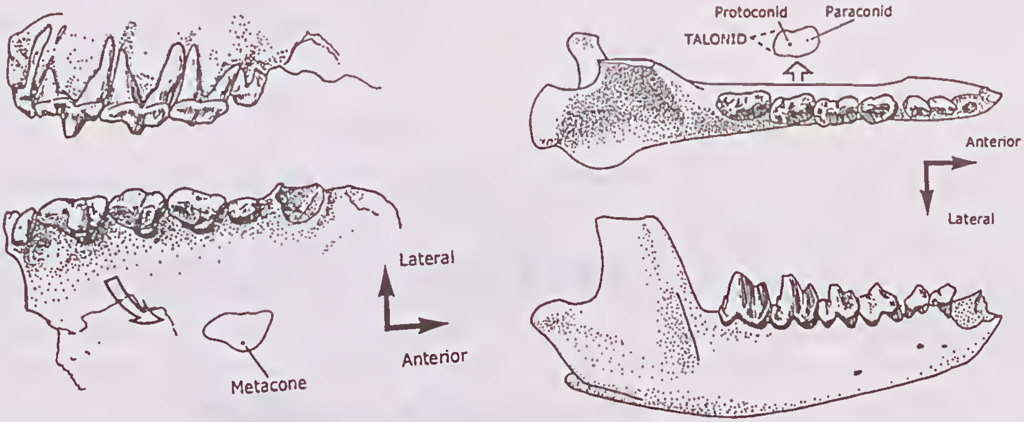

Figure 4. The teeth of a fossil devil, *Sarcophilus laniarius* (this may be the same as the living *Sarcophilus harrisii*). Again this is based on actual specimens in the Queensland Museum (the uppers, at left, from Rockhampton and the lowers, at right, from the eastern Darling Downs) to show what actual fossil teeth may look like. The uppers especially are somewhat worn and broken with the tips of some cusps of the lowers broken as well. The stylar shelf is reduced on the upper molars and the metacone is the most prominent cusp. In the lower molars the talonid is much reduced and the protoconid the most prominent cusp. Not to scale.

Thylacine teeth are not common, but they do turn up from time to time, in fact, they probably aren't much less common than devil or dasyurid teeth. The upper molars of *Thylacinus* resemble dasyurid teeth, but with a smaller stylar shelf and smaller protocone, and the protocone and metacone are relatively closer together

than in other dasyurids. Again, the last molar is modified like those in other dasyurids. In the lowers, the protoconid is quite strongly developed compared to the other cusps and dominates the tooth, so the teeth appear rather different from those of smaller dasyurids.

BANDICOOTS

The molar teeth of the primitive (plesiomorphic) bandicoots, such as *Peroryctes*, don't differ much from the basic pattern with the upper looking much like those of typical dasyurids. Viewed face-on, the upper molars are roughly triangular, most of them with the inner (lingual) angle truncated - only the last is really triangular. These carry the usual set of three cusps, but some have a fourth, the hypocone, adjacent to the protocone, they also have a stylar shelf, however these forms inhabit New Guinea, not Australia.

The Australian bandicoots, have teeth that differ from this basic pattern, here we show *Isoodon*, the Short-Nosed Bandicoot (Fig. 5). In occlusal view the upper molar looks like not one but two triangles joined together, this pattern arises from the development of prominent cusps along the outside margin of the crown, which rival the paracone and metacone in size. The protocone is very small and is part of a low shelf along the inner face of the crown, this gives the molars a squarish or quadrangular form. (In *Macrotis*, the Bilby, the shelf is not developed, but the protocone is still small, an inside adjunct to the paracone).

The lower molars of bandicoots, viewed face-on, also look like two triangles joined at one angle (Fig. 5). Near each angle of the joined triangle arises a sharp cusp. The lower molars of bandicoots look like the basic tooth pattern for therian lower molars, however, the paraconid is small, and the cusps of the talonid, the endoconid and hypoconid, are as large as the metaconid and protoconid.

We will look at kangaroo, diprotodont, wombat, possum and koala teeth in future parts of this article. Finally, remember that teeth get worn, so that the patterns described here may become obscure, or even - if the animal had a long life - obliterated. In that case it becomes very difficult to identify the teeth.

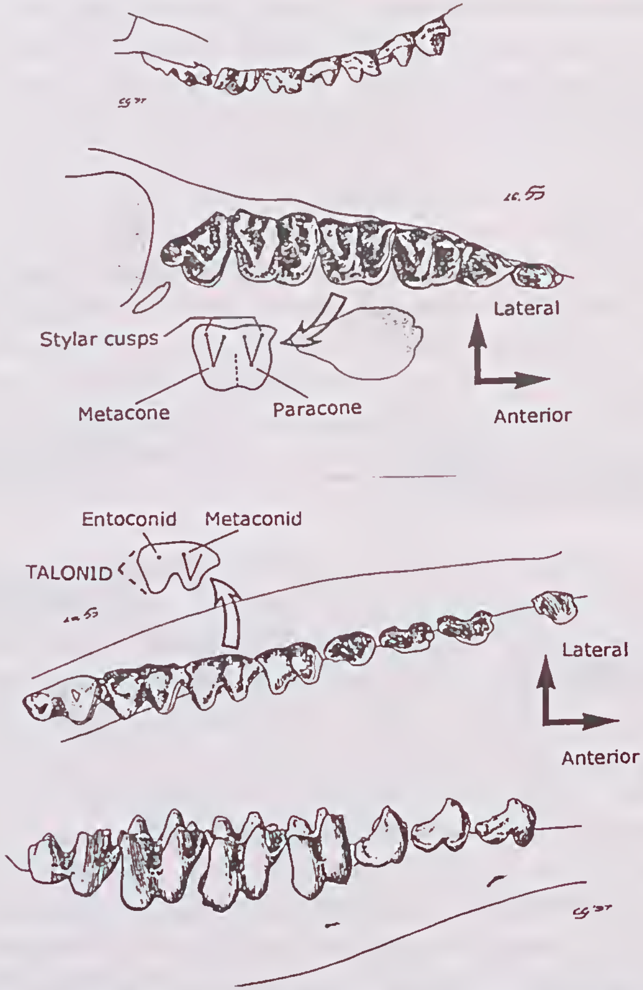

Figure 5. The teeth of a Northern Brown Bandicoot, *Isoodon macrourus*, from a specimen that lived near Cairns. Australian bandicoots show a more derived tooth form than that of marsupicarnivors. The uppers (top) have a reduced protocone and a marked 'valley' that disguises the basic triangular pattern, in addition there is a set of prominent stylar cusps, of about the same height as the paracone and metacone. Thus the cusps and ridges of the upper molars form almost a W-like pattern. The lower molars (bottom) are closer to the basic scheme, the talonid is well developed and the entoconid and metaconid are about equally high, although the other cusps are almost as high. Not to scale.

Suggested Further Reading

Archer, M., & Clayton, G., eds., 1984. *Vertebrate Zoogeography & Evolution in Australasia.* (Hesperian Press: Carlisle), 1203 pp. The chapters on mammals, especially 6,7 give much valuable information on mammal teeth.

Rich, T. H., 1991. Monotremes, placentals and marsupials: their recored in Australia and its biases. In, P. Vickers-Rich, J. M. Monaghan, R. F. Baird, T. H. Rich, E. M. Thompson & C. Williams, eds., *Vertebrate Palaeontology of Australasia.* (Monash University Publications Committee: Clayton), pp. 893-1004. Good picture of the teeth of many fossil mammals, and also some information on the teeth of introduced mammals.

Young, W. G., Jupp, R., Kruger, B. J., 1989. *Evolution of the Skull, Jaws and Teeth in Vertebrates.* (Dept. of Oral Biology and Oral Surgery, Univ. of Queensland: St. Lucia), 274 pp. Covers the structure, different forms, function and evolution of teeth: gives an introduction for what teeth are all about.

Merrilees, D., & Porter, J. K., 1979. *Guide to the Identification of Teeth and Some Bones of Native Land Mammals Occuring in the Extreme South West of Western Australia.* (Western Australian Museum: Perth), 152 pp. The *only* guide available on identifying fossil bones (of any kind!).

THE FOSSIL EXCHANGE

Jean-Guy Pellerin of 2288 De Lorimer, Montreal, Quebec, CANADA H2K3X3 [telephone (514) 524-7836], is interested in trading fossils with Australian collectors. He is particularly interested in echinoderms (echinoids and crinoids), vertebrates (mammals and fishes), trilobites, and plants (ferns, woods and flowers) and has similar material for exchange. He is also interested in exchanging palaeontological literature (photocopies) and will supply details of material available on request.

(Collectors in Australia who may wish to trade with Jean-Guy are reminded of the Protection of Movable Cultural Heritage Act 1986 and any State laws which apply to the collection of fossil material. Ed.).

PRESERVATION OF THE REDBANK PLAINS FOSSIL SITE, SOUTHEAST QUEENSLAND

Alan Rix, Brisbane.

Readers may recall my interim report on preservation of the Redbank Plains fossil site (*The Fossil Collector*, 40, May 1993. page 5), in which I outlined efforts to protect the site from proposed housing development. I can now advise that ownership of the site has been transferred to the Ipswich City Council, to be protected as a reserve, and a management plan will be drawn up in the near future.

The Redbank Plains fossil site is an important early Tertiary locality, well known for its fossil fish and insects, and more recently for bird and turtle fossils. Apart from the nearby Dinmore locality (which produces mainly plant fossils) the site in question is the last remaining fossiliferous outcrop of the Redbank Plains Formation, an Eocene lacustrine deposit that lies under some of Brisbane's outer south-western suburbs. Being in the midst of Australia's fastest growing urban area, it was only a matter of time before this bushland area was developed for housing.

Efforts began in 1992 to plan for the fossil site. With the great support and generosity of the owners of the land, and the backing of the Ipswich City Council, which is very conscious of the geological and cultural heritage of the area, arrangements were made to recognise the fossil site as part of the parks contribution of the larger housing development plan, and transfer of the land was made to Council well ahead of the surrounding property being developed. The site was surveyed at the owners cost and they made substantial efforts to ensure that the transfer took place smoothly. Likewise, the Ipswich City Council (from the mayor down) gave the proposal its full support, as did the Queensland Museum. A management plan will be prepared in due course but it is intended to leave the site in its natural state, as far as possible. A heritage nomination is being finalised.

It is good to know that property owners/developers and local government can recognise the importance of sites such as this and contribute their time and resources to assist in preservation. Maintaining the Redbank Plains fossil site as a reserve in perpetuity will enable work to continue in finding and studying more vertebrate and invertebrate material from the site, and learning more about the development of the Australian fauna in the early Tertiary Period.

BOOKS AND BOOK REVIEWS

THE GREAT ARTESIAN BASIN. by Alex Cook and Don McKenzie. M'Choinneach Publishers, P.O. Box 3, Ilfracombe, Queensland 4727, vi + 54p. (1997). ISBN 0 646 31779 2. Price $10.00, plus postage and handling of $2.50. Available from Alex Cook. Geology, Queensland Museum, P.O. Box 3300, South Brisbane, Queensland 4101.

In the 'Preface', the authors state that this small (60 page, A4 size) volume "is intended to interest the traveler with an account of the main features of the Great Artesian Basin and its history." In doing so, they have succeeded in giving an excellent and concise 'Introduction' to the extent and formation of the artesian basin, followed by a generally easy to understand overview of the basin's 'Landforms and Vegetation', 'Economic Activity' - discovery, early human activity and settlement, social developments and industrial resources, 'Geology', and finally, a brief account of the 'Fossils' found in the Jurassic and Cretaceous rock of the basin.

While geology orientated field guides are published by both amateur and professional groups from time to time, it is refreshing to find a text that gives equal emphasis to the effect that a region's geology, landforms and vegetation has on human settlement.

Surprisingly, I found the chapter on the geology of the basin, and to a lesser extent the landforms, the least easy to follow; no doubt due to my lack of specific knowledge of the geography and topography of inland Queensland. To follow the multiplicity of topography and stratigraphic names mentioned in the text, most readers will need to refer to a detailed map showing where these features occur in relation to commonly known towns, highways and physical features. Unfortunately, although there are excellent maps showing the extent of the inland sea during various geological stages (Figs 9-13), the only large map, a plain paper insert, while showing geological features is otherwise poorly annotated.

While I'm sure all of us would like to have seen more information on the Basin's fossils (only seven pages), what has been included is easy to read and well illustrated with black and white photographs, although I found the haphazard

notation of the plates irritating.

All in all, this is a very useful and informative guide to one of Australia's most important geological features and it is indeed hoped that companion volumes will follow.

Reviewed by Frank Holmes

MOVABLE CULTURAL, HERITAGE PROTECTION.

According to the Annual Report of the National Heritage Committee for the year 1996-97, applications for permits to export palaeontological material totaled 46 per cent of all applications received under the provisions of the Protection of Movable Cultural Heritage Act 1986.

While this was a decrease of 17 per cent on the 1995-96 figure, the Committee still consider the number of palaeontological applications unacceptably high, the majority, according to expert examiners, relating to material of little or no scientific or cultural significance, e.g. over 4500kg of petrified wood covered by 12 separate applications.

Steps are being taken to address this problem by a revision of the Control List, details of which are yet to be finalised.

Finally, it is interesting to read in the Annual Report that no applications for export permits were refused during the year.

Editors Comment: While I agree that controls on the export of palaeontological material need to be in place, perhaps the way in which permits are issued should be reviewed. The need for expert examiners to examine the material in all exports should remain, but if the material is only petrified wood or common marine invertebrates etc., then perhaps the process for granting a permit could be a little easier. Then perhaps, after the permit has been granted, customs officers should open and re-examine the contents of all palaeontological exports to see if it conforms with the original list and if there is any doubt the expert examiner named could be contacted to review to contents of the export. Of course if the permit is for an unusually large amount of material questions should be asked. The above is the view of the editor only and in no way reflects the position of the F.C.A.A.